DIRECT SEEDING ALONG HIGHWAYS OF WOODY PLANT SPECIES UNDER A WOOD-CHIP MULCH

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•DURING highway construction, natural communities of plants are completely destroyed; the bare road banks are subjected to full exposure to the sun, fluctuations in temperature, changes in moisture conditions, and erosion. Such adverse conditions make it difficult for most plants to become established, and it may take years, if left alone, before the bank becomes stabilized with vegetation. However, with the use of wood-chip mulches and the seeding of selective woody plant species, vegetation would quickly heal the scars of construction.

At the present time, shrubs and trees are planted along slopes in Massachusetts mainly to restore a natural balance in the roadside design (2). The cost of plant materials and planting is very expensive. Direct seeding would reduce this cost, speed-up vegetation on areas where it is hard to plant grass, and would allow diversity in the species that could be planted. Very little work has been done on the direct seeding on roadside slopes of woody plant species under a wood-chip mulch. Direct seeding of native shrubs along highway slopes was first suggested by William C. Greene in 1957 (3). Because the burning of trees, brush, and trash is banned in Massachusetts, wood chips become a valuable by-product that can be used as a mulch on new seedings and for erosion control on slopes. The Massachusetts land area is composed of approximately 60 percent forest; therefore, a good supply of wood chips should be available for use during road construction. Mulching (1) has become an integral part of seeding operations for erosion control and better seed germination, and various mulches are used according to their cost and availability.

In November 1964 (4), seeds of various woody plant species were seeded on a roadside slope using different kinds of mulches. Seed germination was best under the wood-chip mulch.

The purpose of this investigation was to determine the possibility of establishing species of woody plants from seed under a wood-chip mulch.

GREENHOUSE EXPERIMENT

Materials and Methods

Wooden flats, 12 by 24 in., were divided in half to make two, 1-sq ft planting areas. These were filled to a depth of $1\frac{1}{2}$ in. with a soil mixture that was composed of two parts loam and one part sand. Fifty viable seeds of four woody species of different seed size were used per plot (Table 1). Seeds were lightly covered with soil. Four different depths of mixed hardwood chips that were previously passed through a $1\frac{1}{2}$-in. mesh screen were used as a mulch. The check plot had no mulch. The plots were replicated three times. The seed treatments before seeding were (a) bristly locust—seeds immersed in hot water (water heated to 212 F) and allowed to soak for 8 min as the water cooled; (b) Tatarian honeysuckle (same as the previous treatment except water was brought to a temperature of 175 F); (c) indigo bush—seeds immersed in sulfuric acid for 10 min; and (d) dyer's greenweed—no treatment.

The check plot with no mulch was watered every day, and the mulched plots were watered 1 to 2 times weekly. Seedling emergence counts were taken during a period of 2 months after seeding.

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Table 1. Seed count per pound and seed weight (in milligrams) of various woody plant species. Percentage of seedling emergence under four depths of wood-chip mulch.

Species	Number of Seeds per Pound	Seed Weight (milligrams)	Percentage of Emergence: Check (no mulch)	1 in.	2 in.	3 in.	4 in.
Arnot's bristly locust (Robinia fertilis Arnot)	25,560	18.3	44	60	50	32	6
Indigo bush (Amorpha fruticosa L.)	45,536	6.8	18	24	12	0	0
Dyer's greenweed (Genista tinctoria L.)	118,948	3.7	6	5	2	0	0
Tatarian honeysuckle (Lonicera tatarica L.)	165,256	2.8	50	60	5	0	0

Results

The emergence data (Table 1) show that large seeds were able to emerge through 2 in. or more of wood-chip mulch. Small seeds evidently do not have enough stored energy in the form of carbohydrates to push a sprouting seedling through a thick layer of wood chips. Bristly locust had 60 and 50 percent emergence under the 1- and 2-in. layers of mulch respectively. It appears that use of the 2-in. depth of wood chips on roadside slopes would give satisfactory emergence of the bristly locust and would also control erosion.

Tatarian honeysuckle had 5 percent emergence through a 2-in. layer and 60 percent through a 1-in. layer of mulch. However, a 1-in. layer of wood chips may not be satisfactory for erosion control on a steep slope to be seeded with this plant. Another method of mulching must be found for species whose seedlings do not emerge through the 2-in. depth if they are to be seeded successfully on steep slopes. The value of a mulch is illustrated well by comparing the percentage of emergence of seedlings in the check plot with those under the 1-in. mulch. This is manifested well in the test results of bristly locust, indigo bush, and Tatarian honeysuckle (Table 2).

Table 2. Number of seeds per pound and treatment of seed before seeding. Plant count per square foot (6 replicates) from 10 viable seeds and average height of seedlings in 1970 and 1971.

Species	Number of Seeds per Pound	Seed Treatment Before Planting	8/26/70 Average Number of Seedlings per Square Foot	8/26/70 Average Height (in.)	11/3/71 Average Number of Seedlings per Square Foot	11/3/71 Average Height (in.)
Indigo bush (Amorpha fruticosa L.)	45,536	Scar.[a] (hot water, 5 min)	8	2	7	10
Oriental bittersweet (Celastrus orbiculata Thunb.)	56,024	Strat.[b] (peat moss 112 days cold)	2	1½	1	—
Bayberry (Myrica pennsylvanica Lois)	19,976	Mech. scar. to remove wax; strat. peat moss 118 days cold	6	1½	3	11
Autumn olive (Elaeagnus umbellata Thunb.)	27,694	Strat. (peat moss 118 days cold)	6	2	5	16
Japanese larch (Larix leptolis Sieb. and Zucc.)	95,612	Strat. (peat moss 90 days cold)	0	—	0	—
Spanish broom (Spartium junceum L.)	38,453	None	13	3	0	—
Red cedar (Juniperus virginiana L.)	50,076	None	0	—	5	2
Black locust (Robinia pseudoacacia L.)	24,516	Scar. (hot water, 5 min)	9	4	8	41
Fragrant sumac (Rhus aromatica ait.)	22,382	None	1	—	5	3

[a]Scarification: water brought to boil and seeds immersed as water cooled. [b]Stratification: temperature of 41 F.

The percentage of emergence of dyer's greenweed was low because of seed embryo dormancy. Tests conducted since this experiment show that cold stratification for 90 days at 41 F will overcome this dormancy and increase germination to 72 percent.

ROADSIDE EXPERIMENT

Materials and Methods

A north-facing 2:1 fill slope in Gardner, Massachusetts, consisting mostly of a sandy loam texture, was used in this experiment. Plots 5 by 25 ft, replicated two times, were set out near the top of the slope. Seeds of nine different woody species (Table 2) were broadcast to give 10 viable seeds per square foot of plot on June 16, 1970. Some seeds were given a pretreatment before seeding. Two in. of wood-chip mulch were hand-spread over the area. Data were taken on germination and the height of plants.

Results

Seedling counts (Table 2) of indigo bush, bayberry, autumn olive, and black locust, taken August 26, 1970, showed good density and emergence under the 2-in. depth of wood-chip mulch. Survival was good the first and second years. Because there is no competition from other vegetation, there are more plants than necessary for the area.

Red cedar and fragrant sumac seed did not receive any treatment before seeding and therefore did not germinate until the second year, after a good stand had been established. Seeds of these species will not germinate when seeded in the spring unless they are stratified prior to seeding. Fall and natural seedings remain on the ground through the winter and pass through a period of natural stratification.

Oriental bittersweet and Japanese larch were rated poor in performance. Many of the seeds of the former species were rotten after being stratified, whereas the seeds of Japanese larch evidently were too small (Table 2) for many of the seedlings to emerge through the 2 in. of wood chips.

Spanish broom had a very good percentage of emergency through the wood-chip mulch and good seedling establishment the first year; however, all plants were winter-killed. This species could be used on Cape Cod or in other areas of the country where the winters are less severe than those in Massachusetts.

SUMMARY AND CONCLUSIONS

Very good results were obtained with the direct seeding of indigo bush, bayberry, autumn olive, black locust, red cedar, sumac, and Spanish broom under a 2-in. depth of wood chips. Better results should have been obtained with Oriental bittersweet and Japanese larch. In a trial experiment, Oriental bittersweet performed very well in 1968. Seed dormancy is common in many of the tree and shrub species. Breaking this dormancy requires some kind of scarification and/or stratification before seeding, especially for spring seedings. With many species, seedings made in the fall require no seed treatment. Various trials were run in the laboratory on the species used in these experiments to determine the best preseeding treatment for best germination. As more information is obtained on the treatment of seeds to break their dormancies, the more successful will become the direct seeding of these species under a wood-chip mulch along highways.

Wood chips are an excellent mulch material. They are weed-free, they prevent the soil from drying out, and they aid germination and seedling establishment. There was no soil erosion on the 2-in. mulched plot area during the entire experiment. Instead of waiting some 15 years for natural vegetation to establish itself on slopes that are mulched with wood chips, it seems more logical and practical to seed, before mulching, species of woody plants that are adapted to these areas. Thus, one provides in the roadside pattern a view of the landscape: the highway, the strip of mowed grass and legumes, and the short woody species that blend into the larger trees and forest to form a natural ecotone.

ACKNOWLEDGMENT

This work was done at the University of Massachusetts, College of Agriculture Experiment Station, in cooperation with the Federal Highway Administration and the Massachusetts Department of Public Works. The opinions, findings, and conclusions expressed in this publication are those of the authors and not necessarily those of the Massachusetts Department of Public Works or the Federal Highway Administration.

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